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Recovering Grand Brownfields

Ecological Landscape, Wetlands & Phytodepuration In Magok Park, Seoul

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***Abstract*—The right to clean water is a vital resource in consolidated emerging urban economies. Alternative fresh water resources and public wastewater management represent one of the most valuable services. However fresh water requires an adequate and advanced depuration technique: the Integrated System of Phyto-depuration (ISP).**

The expansion of mega-cities worldwide has generated many derelict voids. The proliferation of highly polluted brownfields is a constant characteristic, which is likely to continue and increase in future. If left to fall into neglectfulness and urban inertia, these spaces will have a detrimental effect on local neighborhoods in terms of social health, wellbeing, local economies and environmental qualities. The development of urban parks in urban voids has been generically implemented without environmental and ecological recovery strategies. Waterscape is not just an aesthetic feature but also a decisive element in the production of the space. The construction of manmade wetlands (bio-remediators) offers landscape, ecological and environmental qualities that heal polluted environments.

This study explores innovative waterscape systems in the brownfield of Magok basin, Seoul: http://issuu.com/cristiansuau/docs/urban_park_seoul. The landscape design scheme reproduces natural self-depurative processes in a controllable environment by taking into account both the strategic location and necessity for ecological remediation. Innovative water-terracing systems (eco-formations) are proposed as water phytodepuration treatment. It consists of offsetting contaminants on wastewater surface, through the establishing of native plants and aeration. These terraces are dwelled by aquatic plants (macrophytes), which reproduce the natural purification processes frequently in humid climates.

The development of this *"artificial wetland scheme"* is based on octagonal eco-formations. They aim to create a social catalyst as well as a healthy environment, providing recreation and amenities combined with the gray water biological and distillation treatments.

Keywords—Ecological Landscape; Water Park; Waste Water Treatment; Integrated System Phytodepuration (ISP).

I. INTRODUCTION ON MAGOK LAKE PARK

Transformation is an act or process of changing places. Formal or informal urbanisations are the direct output. This phenomenon of massive 'metapolisation' is physically transforming both urban and rural landscapes by creating diffuse and in-transit habitats. The beginning of the 21st century is defined by the radical urban transformations in Asian mega-cities and specially South Korea. How do the incessant urban dynamics affect the infrastructural quality of cities mainly regarding the right to public spaces and clean water? How do urban parks can transform brownfields into vivid ecological wetlands? The design brief aimed to advance water transportation connecting the Han River to the Yellow Sea, while creating a well developed waterfront environment that houses all necessary facilities and amenities and transform the area of Magok [1] into a tourist, commerce, and environment friendly waterfront area (117 Ha) in line with Seoul's Han River Renaissance Project, through the participation and input of various professionals and experts from Korea and abroad. The core planning objectives were: (a) creation of a leisure area equipped with related facilities and amenities; (b) promotion of a sustainable ecosystem and environment of Magok; and (c) alignment with the Han River Renaissance Project.

This study explores the urban co-existence between restored nature and eco-artificiality of a grand basin along the Han River of Seoul, which analyses the spatial and environmental capacities of the Magok area as an ecological aquatic park through a series of waterscapes, transport structures and building types. This design strategy is not only a physical recovery but also covers radical concepts on waterscape [2]. Landscape is understood both as cultural catalyst and also dynamic process rather than a finalised object.

By underlying eco-formations the design scheme offers a distinctive landscape recovery strategy on site. These landforms accommodate an archipelago of ecologies supported by leisure and recreational

amenities through water terracing networks. With a complex system of land-transport infrastructure currently being implemented at Magok, the scheme takes a pragmatic bio-remediation approach by utilising the surface water networks, grey water treatment plants and existing slope.

II. MAGOK WATERSCAPE FEATURES

The waterscape features are characterised by the following distinctive elements:

A. Water-Transport Connectors

Between the Magok site and the Han River sits the Olympic Expressway, which is the main transport spine that connect the shores of the river. The study alters the expressway water barrier (embankment) by placing a buffer frontage with a system of barrage, sluice gates and fish pass to Han River. The significance of this barrage allows that waterfronts and jetties form a regulated inner navigation plan defined by a central waterway route. The tangible significance of having physical access to the river water is essential from a biological and functional viewpoint. Apart from the Han River gateway, there is another waterway connection between the north and south basins. From the Yangcheon-gil road, a floodgate, sluice and fish pass is also proposed to bridge the difference of water levels and to stimulate biological migration through the water-transport route.

B. Wetland Buffers

Along the shoreline of the proposed aquatic park, the scheme establishes a transitional zone that deals with rainfall water and surface drainage to purify the wetland habitat close to the urban edge.

C. Water Terracing

The inner waterfront forms a series of variable 'waterscapes' within the site. These distinctive elements, acting as the surface water treatment system, give visual and dynamic attributes to the Magok recovery plan.

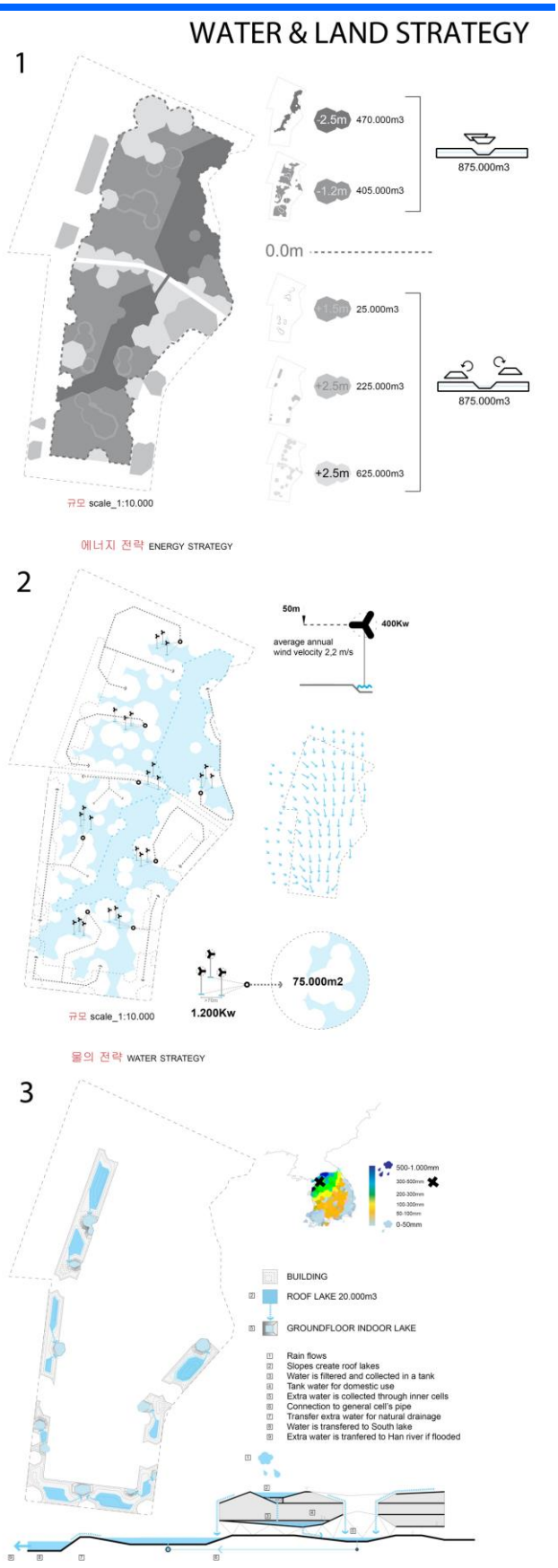

Fig. 1. *Water & land recovery strategy in Magok Park. Source: C. Suau, C. Zappulla, P. Henshaw, K. Hong, T. Vlasceanu, E. Rovira, M. Tepedino, N. Toribio, 2008.*

III. WATER TREATMENT MANAGEMENT IN MAGOK LAKE PARK

The Han River barrage is a key project in the regeneration of Magok Waterfront. It secures freshwater for the whole basin. The barrage is a 24/7 service operated by Magok harbour authority. The change from greywater into freshwater creates a unique public space throughout:

A. The river barrage

It consists of three sluice gates, two locks which allows drain down of impoundment and migratory fish to pass. It also acts as flood defense.

B. Environmental management of dissolved oxygen

Water basin requires dissolved oxygen level within the impoundment to be maintained at or above 5mg/l constantly by using water mixed system (pipes, compressor stations, diffuser heads and oxygenation barge).

C. Water quality monitoring

It consists of digitalised data collection of dissolved oxygen, pH, temperature, conductivity and turbidity from several monitoring stations.

D. Debris/litter management

Debris deposited in the area is collected and disposed of on a daily basis. Waste is removed from water by using floating bulldozers or water-witches (one tonne scoop lifting capacity). Then collected debris is separated wherever possible for recycling purposes.

E. Han river intrusion

A standard of low salinity within the inner manned lagoon would be maintained to protect freshwater ecology. River water entering the Magok reservoir via locking operations would be contained within a constructed underwater 'sump' immediately lakeside of the locks to regulate water flow.

F. Migratory acuatic fauna

A migratory fish-monitoring programme is set up. Native fish stocks can be monitored and maintained.

G. Aquatic weed management

Conditions within the wetlands and inner lakes margins are favourable for the growth of aquatic weed. A purpose built amphibious vessel would be deployed for cutting weeds to a maximum depth of 1.5 metres to maintain navigable channels and also allow access to shallow areas for litter control.

H. Wetlands reserve

The Magok Waterfront can be undertaken to further enhancement of the habitats for various fauna in the south and north basin to maximise the potential for roosting and breeding.

Fig. 2. *Water Management Plan in Magok Park. Source: C. Suau, C. Zappulla, P. Henshaw, K. Hong, T. Vlasceanu, E. Rovira, M. Tepedino, N. Toribio, 2008.*

IV. TRANSPORT STRUCTURES IN MAGOK LAKE PARK

The urban structure responds systematically to the main land-transport network linking Seoul city centre with Gimpo and Incheon international airports. It consists of:

A. *Car road system*

The core spine is led by expressway supported by a perimeter network of straight and undulating roads, a non-imposing road grid but a scenic by prioritizing the natural environment. The scheme reconfigures the Olympic Expressway underground allowing direct visual and pedestrian access to the river frontage. There is a hierarchy of roads implemented within Magok site and link to existing infrastructure surrounding the site (low-speed streets). The secondary roads that reach water become 'jetty-settlements'. The Magok scheme incorporates a local network of pedestrian and cycling as part of the low-carbon planning. The Han River frontage offers scenic routes, which are highlighted by attractors such as the cultural zone: development bands; waterbus stops; high-rise towers: and recreational centres.

B. *Cycling routes*

An integrated cycling network is proposed. The main circuit follows the shoreline of the two lakes linking all programmes. Secondary pathways branch off to connect directly the strategic links within each zone. The scheme envisions an ecological itinerary mainly for resting (like cycling milestones or point) along the central cycling line as a linear public place or corridor in motion between city tissue and marshland. It aims to resolve the current physical disconnections by intertwining wetlands, river and new urban developments. The hard infrastructure consists of info-points (tourist attractions) and pavilion-rotors; public furniture; branding and signage; and line-marking.

The soft infrastructure is supported by WIFI tracking; traffic and climatic sensors; and data collectors along the mayor land-transport network; riverside area; and train and airport terminals. The complementarity between hard vs. soft infrastructures allow the programmatic activation of all edge conditions; new capacities and opportunities for smart mobility among every-day residents and tourists. Between the water terracing and islands, with gentle gradients along with varying ecologies from cycling is allocated to connections with major public transport nodes. A rental bike network is implemented in strategic crosses.

C. *Public Transport. There are two main internal public transport system:*

- Over-ground transport bus service, which follows the internal roads and link with both the train station and the Gimpo and Incheon International airports.
- Waterbus, a central aquatic line connected to bike parking and stops: convention center (south side); old pump station (middle) and the barrage (north side).

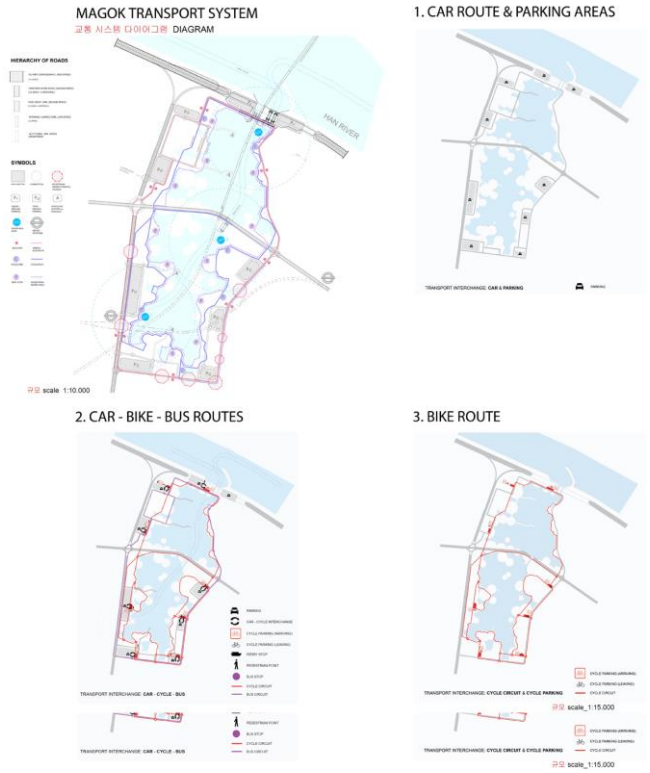

Fig. 3. *Integrated land-transport network. Source: C. Suau, C. Zappulla, P. Henshaw, K. Hong, T. Vlasceanu, E. Rovira, M. Tepedino, N. Toribio, 2008.*

V. ECO-FORMATIONS

The water phyto-depuration landscape strategy is taking shape through 'eco-formations', eco-cells and wetland terraces.

This manned archipelago operates twofold: (1) *providing recreation and amenities on site but also* (2) *performing as ecological catalysts of water purification* (biotypes of flora, restored soil and water treatment filtration).

A. *Eco-cells*

The Magok Waterfront is composed of polygonal formations that create a land-form of convexities and concavities. Each base cell unit creates an evocative place reminiscent of flooding rice fields. They are able to purify the grey water of this new parkland.

B. *Wetland terraces*

The terracing scheme is connected to the hydro-oxygenation farm system. It serves as a purification and drainage organism. It becomes denser towards the periphery where the ‘cracks’ terminate.

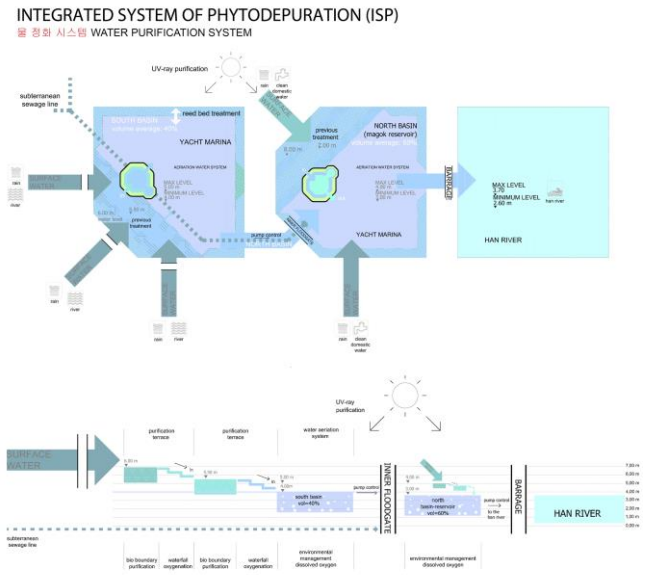

Fig. 4. *Details on Eco-formations. Source: C. Suau, C. Zappulla, P. Henshaw, K. Hong, T. Vlasceanu, E. Rovira, M. Tepedino, N. Toribio, 2008.*

VI. MAGOK LANDSCAPE STRATEGY

The phenomenon of mega-cities worldwide has generated a *'Grand Paysage'* of large derelict voids. If left to fall into neglectfulness and urban inertia, these spaces will have a detrimental effect on local neighbourhoods regarding environmental quality, social health and local economies. Generally the socio-cultural, technologic and economic functions of urban parks offer an improved quality of life; ludic events; enjoyable hobby for relaxation and the deployment of smart landscape technologies.

Parklands provide places to play and learn about nature and technologies as well as stimulate people encounters in cities. The implementation of a lagoon supported by a built edge of mixed uses allows a variety of social, environmental and economic benefits.

The Magok Park performs as a catalyst for community actions; produce an improvement in the aesthetics and rebrand stigmatized residual areas; contribute to the green infrastructure of the city; and provide safe public places for future local dwellers. Nonetheless there exist some significant obstacles to developing parks such as the level of soil toxicity in brownfields.

The improvement of water conditions is essential [3]. The amount of specific treated water drained towards the basin contributes to the improvement of environmental water surface and therefore the Han River's ecosystem. The cascading effect of water by gravity originates a diverse terraced waterscape.

A. Water Treatment

It is carried out in three levels: water pre-treatment in upper basin; reed beds (macrophytes) in the both basins and cell purification. The initial water treatment (gravel filter) retains solid materials on water (suspended solids separation); the second water treatment is defined by a system of lagoons separated in diverse channels and reed beds' pools that makes circulate the water slowly. The water oxygenation occurs by cascading the water surface of basins. The third treatment is partly made through the offsetting of nitrogen and phosphorus.

B. Drainage

It is treated and stored in open pools.

C. Vegetation

Only native flora has been selected. The plantation array consists of:

- *Outer reed beds. In the horizontal flow systems, macrophytes species were chosen (Miscanthus Sacchariflorus; Phalaris Arundinacea; Sparganium Sp. and Typha Orientalis).*
- *Riparian vegetation: Salix as stabilizers against flood and wind (Gacilistyla; Koreensis; Matsudana; and Purpurea types).*
- *Inner reed beds: The chosen vegetal filters are Phragmites Australis; Phragmites Japonica and Iris Pseudacorus.*
  - Drainage vegetation. These species create shaded and fresh corridors: Ulmus Davidiana Japonica (25%); Polulus Euroamericana (60%); Zelkova Serrata (5%); and Sophora Japonica(10%).
- *Floating vegetation. Groups of floating vegetation are allocated in all open pools to restored the Nitrogen and Phosphorus balances in major basin.*
- *Recreational vegetation (gardens). The following aromatic fruit tree species are established in eco-formations: Prunus Avium, Prunus Cerasifera, Prunus Serrulata and Magnolia Grandiflora.*

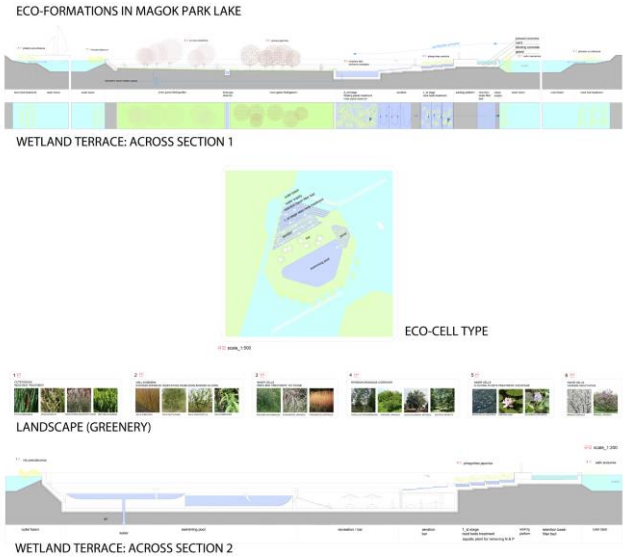

Fig. 5. *Magok landscape strategy. Source: C. Suau, C. Zappulla, P. Henshaw, K. Hong, T. Vlasceanu, E. Rovira, M. Tepedino, N. Toribio, 2008.*

VII. STRATEGIC ZONES IN MAGOK MASTER PLAN

The master plan of Magok Lake Park is divided in five strategic zones:

Zone A. The barrage (floodgate)

Zone A connect the Magok basin with the Han River. The Han River's highest water level (200 years frequency) is +12.31m, and the Olympic Expressway riverbank is approximately +14.00m. The managed water level of the Magok Waterfront for flood control is about 3.70m - 6.00m. The barrage controls the vessels access, water supply and quality management. The sewer lines lain along the Olympic Expressway have been adjusted to 0.5m for the entering of ships.

The location, shape, size, and design of the floodgate take into account urban and nautical communication; flood hazards and landscape amenities. It constitutes a landmark, which provides distinctiveness and symbolism. At ground level (+14.00m), you find an internal road, pedestrian and bicycle paths along the dyke of the Han River. The barrage is able to prevent the backflow of water 3.70m above the normal water level in times of heavy rain and increased water level (vessels are not allowed to operate during heavy rainfall). As result, this master plan offers an alternative subterranean pass of the Olympic Expressway along the Zone A (the construction of a new pump station on the barrage is required).

Zone B. Magok reservoir and eco-formations

It consists mainly of new waterways and wetlands established in the north basin (Magok reservoir) well connected to Zone C, the Lake Park. The basin stores circa 200,000M3 of water. The waterway allows waterbus and large-size vessels to navigate along the lake parks allowing an intermediate zone –wetlands- as ecological and recreational formations along the inner shore, which change according to higher or lower water levels resulting from flooding or dry seasons. Magok reservoir is a leisure area, fully accessible by Seoul citizens and marina users.

The vegetation of the outer zone of the waterside areas does not interfere with the flow of the water into the reservoir in the event of flooding. Marinas are allocated along jetty settlements. The main waterway - which connect the south side (Metro stations' junction) with the barrage- allows the pass of passenger waterbuses.

Three waterbus stops have been purposed: two in Zone C and one in Zone A. The 'eco-formations' –mini wetlands that perform as water purifying buffers- are shallow. They filter all surface water. The Magok reservoir establishes a mutual relationship between the wetland and dockland along the shore, in terms of specific urban interventions; scenic views; and seasonal recreational activities. Its waterfront considers pedestrian and bicycle routes in Zones B and C.

Zone C. The Lake Park

The Zone C consists of the Lake park, inner floodgate and development areas. The Lake park is located within Zone C and acts as the core of the Waterfront. The reservoir stores about 130,000M3 of water. The Lake Park is an open air space for leisure. It accommodates various activities like water games; cultural follies; sports and recreational pitches; resting points and walking paths.

Inner floodgate: The main waterway for passenger boats and vessels connects the south side (Metro stations' junction) with the inner floodgate and the barrage. The waterway allows waterbus and large-size vessels to navigate along the lake parks allowing an intermediate zone as ecological and recreational formations along the inner basin shore. The Lake park is also a leisure area, fully accessible by residents, visitors and marina users.

The Lake Park establishes a mutual relationship between the aquatic programme along the basin shoreline, marinas and dockland as well. Temporary and seasonal outdoor activities (marina club, cafes, and booths) are introduced along the waterfront.

The Development areas contain the built programme along the edge of the Magok Lake Park. They are mid-rise continuous bands of retail, recreation and culture programmes, which are adjacent to the main transport nodes. The oeverall programme consists of a convention center; hotels; office development; restaurants; shopping mall; SMSs and retails. They are linked to the exhibition centre of Magok. Buildings allow permeability into the waterscape through green roofs and walkways directly oriented to the Lake Park.

Zone D. The Water Treatment Plant

Zone D is a part of the existing Seonam Sewage Treatment Plant area. The redevelopment plan of Seonam Sewage Treatment Plant shrank its footage to half area, creating available spaces for new development. In addition, the ISP method of water purification [4] has been recommended with complementary new facilities consists of an exhibition hall; museum; office development; restaurants and retails; and aquarium. The vacant water tanks are reconverted to accommodate aquatic fauna and diving training

Zone E. Gayang Power Station

Zone E is the site for energy infrastructure to allocate the Gayang substation, waste incinerators and heat fusion generators. The infrastructural Zone E remains subterranean or semi-sunken and covered by greenfields. The former Yangcheon pump station is a listed building, which has been rehabilitated. The Gayang Substation is to remain in its current location.

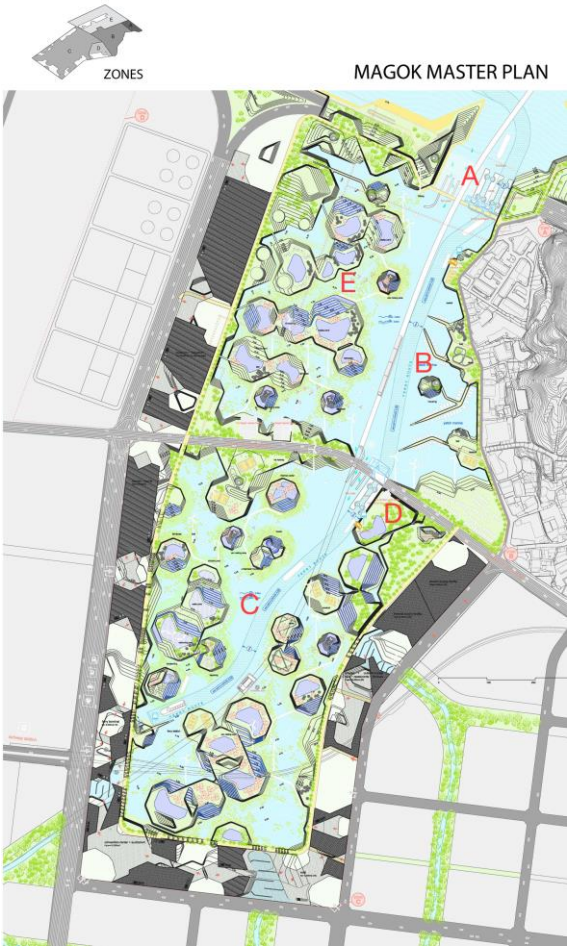

Fig. 6. *Magok Master Plan and strategic zones. Source: C. Suau, C. Zappulla, P. Henshaw, K. Hong, T. Vlasceanu, E. Rovira, M. Tepedino, N. Toribio, 2008.*

VIII. Systematising Landscapes

Whilst we still consider nature as a 'picturesque' or manned-made detached reality, we will never understand its complexity in-depth. Separating manufacturing production from nature provokes the interruption of a prolific dialogue between human technology and environment in transformation.

There are many evidences to suggest that humans are changing the ecological and climatic systems, therefore this dialogue is mandatory. Every place should be seen as a landscape, either natural or artificial.

The Magok proposal considers the landscape no longer as a neutral or passive canvas in which artificial objects or architectonic figures are placed but as a piece of *'urban naturalism'* [5]. This proposal aims to form a territory of co-existence between nature and artificiality. We consider landscape as a whole wherein architecture, infrastructure and services interact with all elements and utilizing them in defining a new urban area.

In doing so, a new landscape -whose boundaries between artificial and natural are diffuse- has been invented. In the construction of a systemic landscape –geometries and elements in relationship- interact with knowledge exchange and bio-techniques in a multi-disciplinary way: Urban strategy, environmental engineering, ecology and architecture [6] to facilitate the variety of scales within the urban and topographic support. Fractal geometries allow us to integrate all the constitutive elements organically, from the territorial to the local scales. In doing so, the design DNI starts from an octagonal unit cell, throughout processes of repetition, fragmentation, scaling and merging. By generating an adaptable tissue, these proto-structures –ruled by its own internal organisational order, amalgam all key design parameters.

The use of constant patterns at different sizes and scales generate self-identity. The tissue is the result of the assemblage of identical cells. Therefore the geometric manipulation of these cell-types forms the systemic landscape by generating the inner shoreline and floating platforms in which all the function are placed. This fractal landscape houses both water purification and management systems constituting a new form of sustainable nature where ecologies –food flows between flora and fauna- are strengthened the recovery of this brownfield basin and the Han River in Seoul.

Acknowledgment

The authors would like to dedicate this study to the memory of Edison Suau Camus - a radical designer, humanistic intellectual and inspiring father- who has recently passed away. This article is the result of trans-disciplinary research-by-design collaborations between architects, landscapers, planners and ecologists. We would like to express our gratitude to all of them. Especially we would like to thank External Reference Architects and ECOFAB universal design's crew and associate partners. We would like to express our deepest appreciation to N. Toribio, P. Henshaw, K. Hong, T. Vlasceanu, E. Rovira and M. Tepedino.

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